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BOATS, BONES, AND BIFACE BIAS: THE EARLY HOLOCENE MARINERS OF EEL POINT, SAN CLEMENTE ISLAND, CALIFORNIA

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By 8000 B.P., sea-mammal hunting and open-sea voyages were established at Eel Point, San Clemente Island, California. The early inhabitants of Eel Point depended heavily on sea-mammal hunting and shellfish collecting, rather than the intensive fishing that developed during the Late Holocene along the Southern California coast. Eel Point technological capabilities rivaled those of Late Holocene groups such as the Chumash Indians, including the ability to fabricate sophisticated watercraft. These data question traditional models of progressive maritime cultural development in coastal Southern California, and reveal the need for more empirical methods of assessing the seafaring capabilities of ancient maritime populations.

Hacia los 8,000 años antes del presente, la cacería de mamíferos marinos y los viajes a mar abierto fueron establecidos en Eel Point(punta Anguila), Isla San Clemente, California. Los primeros habitantes de Eel Point dependíian sobremanera de la cacería de mamíferos marinos y de la recolección de moluscos, más que de la pesca intensiva que se desarrolló durante el Holoceno Tardío a lo largo de la Costa Sur de California. Las capacidades tecnológicas en Eel Point rivalizaban con aquéllas de grupos del Holoceno Tardío tales como los Indios Chumash, incluída la habilidad en la fabricación de embarcaciones sofisticadas. Mientras que tales embarcaciones y las economías intensivamente marítimas han sido consideradas tradicionalmente como desarrollos propios del Holoceno Tardío, los datos en Eel Point subrrayan la importancia de comprender la navegación a lo largo del intervalo temporal completo del asentamientos prehistóricos costero.

> *Established (archaeological) interpretations often survive unquestioned long after the theoretical presuppositions that gave rise to them have been refuted or become unfashionable* [Trigger 1998:695].

Southern California's Paleo-Coastal Legacy

The eight islands fringing the Southern California Bight (Figure 1) contain some of the longest and most detailed records of maritime cultural development on the North American Pacific Coast. Exceptional archaeological preservation, a human occupation spanning twelve millennia, and the obligatory dependence of the ancient islanders on seafaring and marine subsistence make the California Channel Islands an "American Galapagos" for the study of prehistoric maritime cultural adaptations (Arnold 2001; Erlandson 1994; Erlandson and Colten 1991; Erlandson et al. 1999; Glassow 2000; Kennett and Kennett 2000; Porcasi et al. 2000; Raab et al. 1994; Raab, Porcasi, Bradford, and Yatsko 1995). Particularly significant information has been collected during the last decade on the islands' settlement during the Terminal Pleistocene and Early Holocene periods.

The California Channel Islands are usually assigned to northern and southern groups (Power 1980:3). The northern group, consisting of Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands, forms an east-west arc roughly paralleling the Santa Barbara coast. The southern group, including Santa Catalina, San Clemente, Santa

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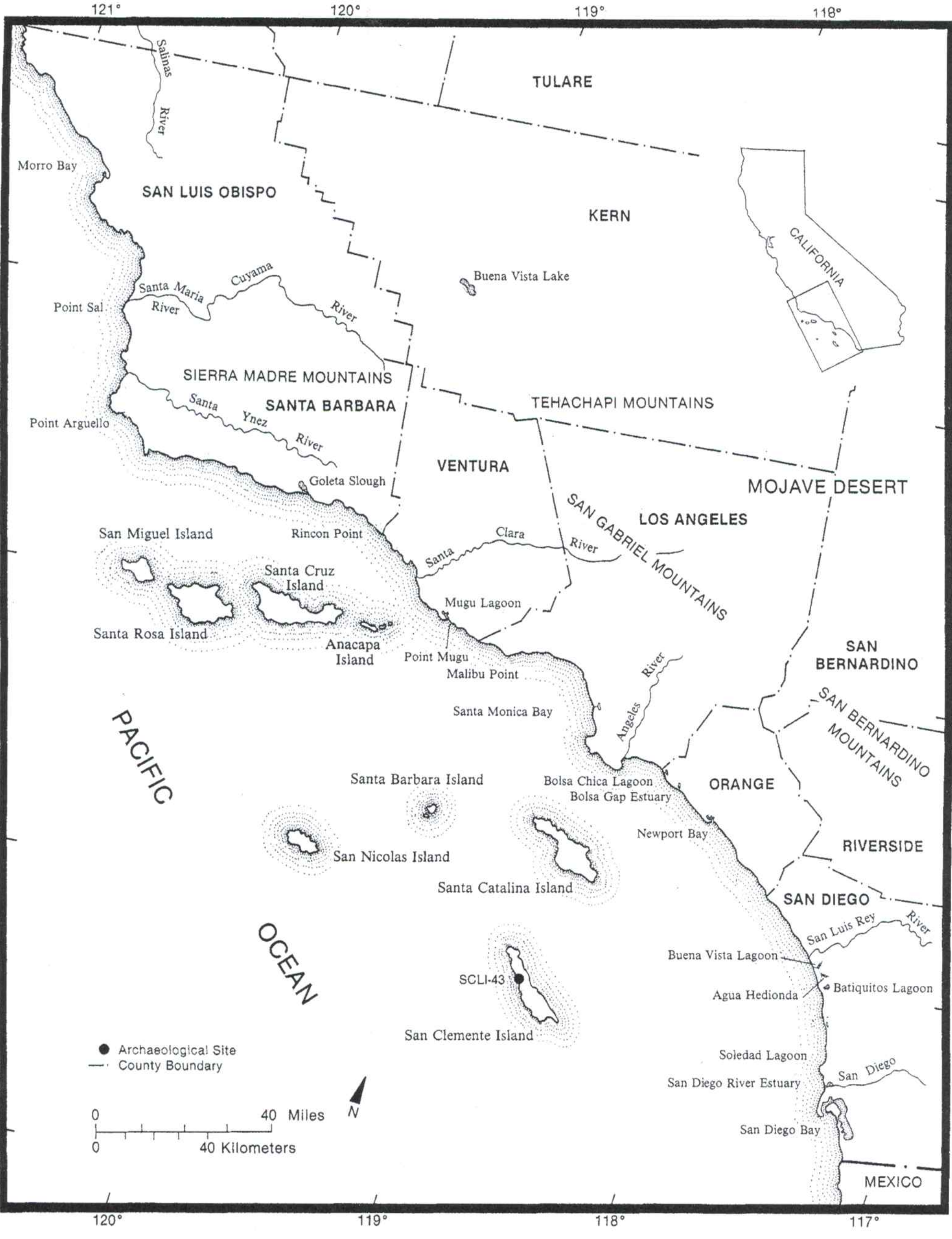

Figure 1. The eight Channel Islands of the Southern California Bight showing the location of the Eel Point site (CA-SCLI-43) on the western shore of San Clemente Island.

Barbara, and San Nicolas Islands, is located off Los Angeles, Orange and San Diego Counties. The northern islands are the remnants of a single drowned Pleistocene island (Santarosae) that once approached to within five to eight km of the mainland (Figure 2). In contrast, the more widely dispersed southern islands are separated from the mainland by deep ocean basins and were always widely separated from the coastline. Terminal Pleistocene archaeological deposits, dating prior to 9000 B.C, are known on the Northern Channel Islands (Erlandson and Colten 1991; Erlandson et al. 1999).

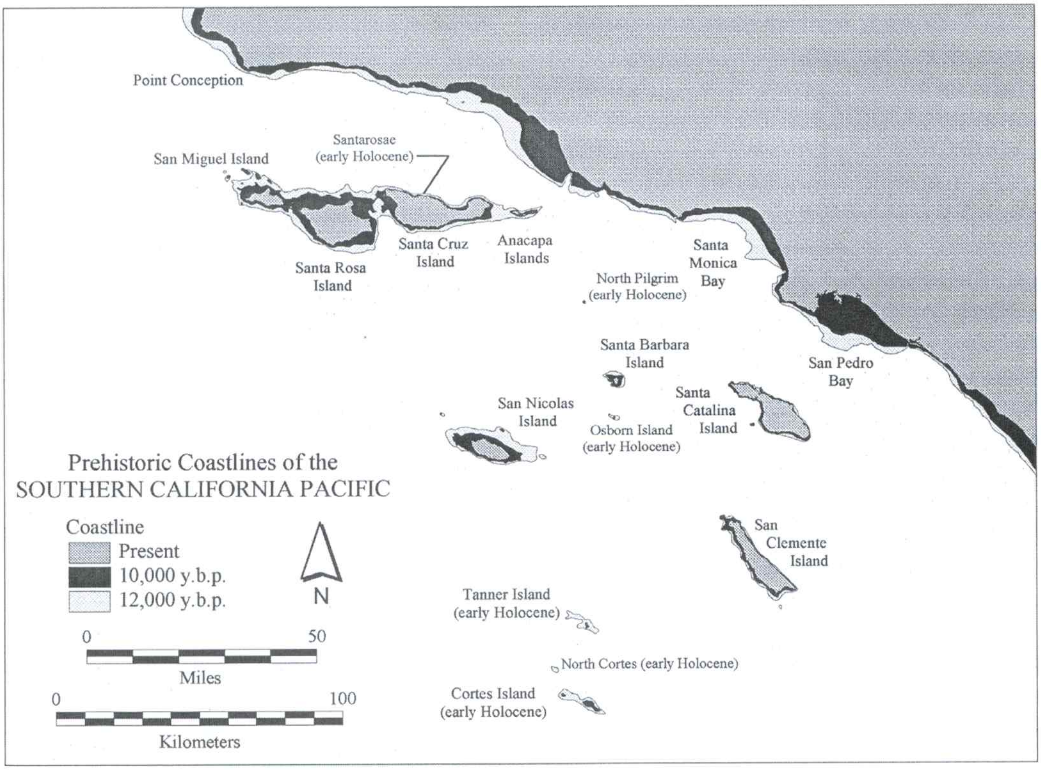

Figure 2. The prehistoric Southern California Bight showing a reconstruction of the prehistoric coastline at 12,000 B.P., 10,000 B.P., and at present (figure provided by Judith Porcasi).

These include "Arlington Springs Woman" on Santa Rosa Island, which is one of the oldest human skeletons in the New World (Johnson et al. 2000). The site of Daisy Cave on San Miguel Island also dates to the Terminal Pleistocene and has yielded the earliest evidence of woven sea grass cordage (Connolly et al. 1995; Erlandson et al. 1996). In recent years more than 11 sites on the Northern Channel Islands of Santa Rosa and Santa Cruz have been identified that date to the Early Holocene between 9000 and 6000 B.C. (Erlandson et al. 1999).

In recent years, substantial progress has been made in southern islands research. One of the most detailed sources of information on early California maritime cultural adaptations comes from the Eel Point archaeological site, located on the central-western shore of San Clemente Island. With an initial occupation of at least 6550 B.C., Eel Point dates near the end of the Early Holocene. The obligatory reliance on sea travel and marine food resources that characterize this occupation afford crucial evidence of early maritime cultural development.

Recent advances in California coastal research are rapidly reshaping long-held theoretical perspectives. Once a largely hypothetical construct, the existence of a California Paleo-Coastal tradition (Moratto 1984) is now firmly established by occupation of the Channel Islands during the Terminal Pleistocene and Early Holocene (Erlandson and Colten 1991; Erlandson et al. 1996: Erlandson et al. 1999; Raab et al. 1994). Archaeological data from Early Holocene sites, including the information presented here, show that maritime cultural traits, including deep-water seafaring and intensive maritime subsistence practices, have their roots far deeper in time than traditional models have suggested.

Correlates of Seafaring

Efforts to understand the techno-economic basis of prehistoric seafaring along the California coast have intensified in recent years. The role of watercraft in the development of social complexity among the Chumash has become a focal point of these efforts, as recent discussions attest (Arnold 2001; Gamble

2002). This line of research illustrates several difficulties that complicate reconstructions of seafaring during any time period. Among these is the scant physical evidence of ancient watercraft themselves. Constructed of wood, fibers, and other perishable materials, most surviving boat fragments in the Channel Islands region are historic or protohistoric, and none appears older than about 1000 B.C. (Gamble 2002).

There are difficulties that go beyond archaeological preservation, however. Surviving boat fragments seem to be clearly associated with the technological tradition of the Chumash Indian *tomol*, or plank canoe, whose construction techniques and role in voyages to the Channel Islands are well documented in the ethnohistoric record (Gamble 2002). Understandably, these studies depend heavily on the "direct historical approach," where current debate focuses essentially on determining how far back in time it is possible to project the appearance of the *tomol* (Arnold 2001; Gamble 2002). The present study, to our knowledge, is the first detailed discussion of the possible archaeological correlates of Early Holocene watercraft use in the region, if not the whole of the California coast. This evidence exceeds the oldest estimates of the appearance of the Chumash *tomol* by at least five millennia (Gamble 2002). This gap is too large to instill much confidence in direct analogs between the ethnohistoric Chumash and Early Holocene voyagers.

This study explores a general analytical framework for the study of seafaring. We emphasize that this framework should include data about Late Holocene groups such as the Chumash, but also needs to give attention to general archaeological correlates of seafaring (Ames 2002). Only in this way will it be possible to overcome problems of watercraft preservation, bring multiple lines of evidence to bear on the problem of understanding prehistoric seafaring, and move beyond the limitations of the Late Holocene ethnohistoric record.

Model building in this area, from our perspective, should incorporate uniformitarian technological principles and characteristics of the marine environments in which prehistoric watercraft were used. As Gould notes, this contextual approach has been employed relatively little in archaeology to date, but is a promising step toward understanding the conditions that shaped prehistoric seafaring: "while winds, currents, weather, and general sea conditions are universally acknowledged by mariners to be of paramount importance in voyaging, archaeologists have only recently begun to deal with these factors in a systematic way" (Gould 2000:79).

It seems safe to assume that ancient boatbuilding traditions were influenced by certain basic factors, including the characteristics of the aquatic environment, available construction materials, and extant cultural traditions, including the technological capabilities of boat wrights; here we focus on the latter. Channel Islands voyagers of all periods confronted fundamental challenges. These can be summarized under three headings: paleo-coastal geography, watercraft design and construction, and selective pressures of seafaring.

Paleo-Coastal Geography

During the Late Pleistocene glacial maximum, sea level dropped approximately 130 m below the current shoreline (Erlandson 1994; Fairbanks 1990). This condition created Santarosae, the progenitor of the Northern Channel Islands noted earlier. This island hugged the mainland coast and enjoyed relatively protected marine conditions below Point Conception. The island also sustained a relatively extensive terrestrial ecosystem, including a Pleistocene-era pygmy mammoth population (Erlandson 1994; Moratto 1984; Orr 1968). Based on these conditions, colonization of the Northern Channel Islands using relatively rudimentary forms of watercraft seems reasonable (Arnold 2001; Gamble 2002).

The Southern Channel Islands presented substantially more rigorous challenges to early maritime settlement than the occupation of Santarosae. The southern islands were never appreciably closer to the mainland coast than they are at present (Porcasi and Fujita 2000), requiring a sea passage of at least 30 km. One result was the necessity of mastering more dynamic marine conditions, since the southern islands do not benefit from the relatively sheltered sea conditions afforded the Northern Channel Islands by Point Conception (Power 1980). Nor did early settlers of the southern islands enjoy the potential subsistence benefits of exploiting the relatively extensive terrestrial ecosystem of Santarosae. San Clemente Island settlers, throughout the prehistoric era, encountered a depauperate

terrestrial environment that made dependence on marine food resources essential to survival (Porcasi et al. 2000; Raab et al. 1994).

Watercraft Design and Construction

Watercraft design and construction cannot be divorced from environmental and cultural factors. The fabrication of bark canoes, for example, was limited to locations where birch or beech trees were available. The apparent association of skin boats (e.g., the umiak of North America and the curragh of Ireland) with frigid northern waters may be related to the solubility of animal-fat sealants (Adney and Chapelle 1983), which may dissolve in more temperate waters. Where large trees, such as cedar or redwood were available, large dugouts were feasible. The use of reed boats, such as tule balsas, was favored in estuaries or relatively calm near-shore waters. Composite constructions of various kinds, such as plank boats, were fabricated where sufficient straight-grained woods could be formed into multicomponent hull members.

The construction techniques noted above resulted in a variety of watercraft types in aboriginal North America, but these craft were not equally suitable for open-sea voyages. Unless constructed from very large trees, the low gunwales of simple dugouts are prone to swamping in heavy seas. Arnold (2001) suggests that this problem may have been a key factor in the development of the *tomol,* as Chumash boat wrights added planks to dugouts, eventually evolving a hull structure formed entirely of planks. Tule balsas could have been used to travel from their mainland points of manufacture to the Channel Islands (where reeds are generally unavailable), but apparently not without fitting these craft with additional bundles to form gunwales to prevent swamping (Hudson and Blackburn 1979; Hudson et al. 1978). The fact that these reed boats soon become saturated, require periodic replacement of damaged reed bundles, and periodic recoating with bitumen (also generally unavailable on the Channel Islands) makes them far from ideal for regular, open-water journeys and prolonged use in off-shore locations.

As a result of trial and error in many coastal regions, effective open-sea vessels tend to exhibit specific design characteristics. Above all, watercraft must maintain buoyancy and stability. Buoyancy is achieved through the displacement of water with a near-watertight hull, while craft stability is achieved through a relationship between buoyancy and the boat's hydrodynamic qualities (Steffy 1994). Minimization of wind drift, the ability to cut through waves, and maintenance of directional stability are all critical elements of hull design. This generally implies the construction of a keel running the length of the boat and a hull of sufficient strength and flexibility to sustain working loads on the boat. The bow and the stern to a lesser degree contribute to hydrodynamic efficiency if they are pointed and curved. As noted above, the gunwales should be sufficiently high to prevent swamping by waves and sea swells, and must be sufficiently far apart to permit placement of crewmembers and cargo (Adney and Chapelle 1983; Gould 2000; McGrail 1983; Steffy 1994). It seems safe to assume that logs suitable for forming such craft from a single billet of wood were rarely available in coastal Southern California. In general, boats that incorporate the design features noted above must be of composite design; i.e., assembled from separate pieces of available construction materials. The Chumash *tomol* is an instance of this type of construction (Arnold 2001; Gamble 2002).

In addition to the availability of appropriate natural resources and technological know-how, the tools found in the archaeological assemblages of sites should provide clues regarding watercraft construction. For example, the manufacture of bark canoes might be associated with woodcutting implements for stripping bark from trees and punches to make holes to lash the craft together. Skin boat construction should be associated with similar woodworking tools, as well as those employed in the processing of animal hides. Dugout canoes are commonly associated with the presence of axes and adzes suitable for heavy woodworking. Reed boats may be accompanied by the presence of knives to cut the reeds and the processing of fibrous plants for lashing materials. As we shall see below, the fabrication of composite structures, such as plank canoes, necessitated an extensive tool kit, including wedges for splitting wood, scraper-planes, perforating implements, caulking chisels, abraders, and sealants. Systematic examination of archaeological tool assemblages, accompanied by replication and use-wear experiments, are logical avenues for understanding the types of watercraft

constructed in coastal and insular prehistoric sites. While these investigations are not likely to reveal the exact form of the watercraft, it may be possible to make a useful comparative assessment of the technological capabilities of seafarers at different times and locations.

Selective Pressures of Seafaring

In contrast to some gradualist models of maritime cultural development in California, we doubt that early voyages to remote locations such as San Clemente Island were accidental or illustrative of a nascent stage of seafaring, employing watercraft that were "rudimentary" or not "fully developed." Although some might imagine winds or currents accidentally carrying simple boats or rafts to the Channel Islands, the maritime foraging and settlement patterns that we describe below cannot be accounted for as the work of castaways. It is clear that Eel Point was deliberately settled, and certainly enjoyed a maritime economy that required competent watercraft. Moreover, the largest southern islands, including remote San Nicolas Island (Figure 1), were occupied by 5000 to 6000 B.C. (Raab et al. 1994). These populations could not have sustained themselves without ongoing contact with the mainland.

While distances to the Southern Channel Islands are relatively short (ca. 30–60 km), small-craft passages are by no means simple. Wind, weather, waves, sea currents, and water temperature can easily make small-craft voyages a life-threatening adventure. For this reason, we believe that regular, open-sea voyaging has always exerted a powerful influence on watercraft design and construction. This activity did not necessarily result in a single type of watercraft, but probably did select for boats that adhered, in general functional terms, to the techno-environmental pressures described earlier. The selective pressures that enforce such a process are powerful and likely to stabilize optimal watercraft designs quickly: successful watercraft designers lived to reproduce themselves and their technological traditions (Ames 2002:44). Based on evidence we consider below, this process likely produced competent open-ocean watercraft from the earliest phases of Channel Islands settlement.

Eel Point Archaeological Site

Eel Point (CA-SCLI-43), located on San Clemente Island, fourth largest and southernmost of the eight Channel Islands (Figure 1), is among the most intensively studied archaeological sites on the California coast. Research conducted at this site affords an exceptionally detailed picture of early maritime cultural patterns, including evidence that the technological and economic capabilities of early maritime foragers have been seriously underestimated.

Contemporary visitors to Eel Point find a mound of shell-bearing midden rising about 3.5 m above the headland of erosion-resistant volcanic rock that gives the site its name.

Perhaps 2 ha at its base, more than 90 percent of this mound has accumulated during the last 4000 years (Raab et al. 1994; Raab, Porcasi, Bradford, and Yatsko 1995). Today, however, Eel Point scarcely resembles the place encountered by its first inhabitants over eight millennia ago. The site's initial occupants selected a shallow natural depression on the lee of a stone outcrop to establish their residential base, probably enjoying a degree of protection from prevailing winds. Occupying an area perhaps 30 m in diameter, this location included substantial habitation structures, hearths, pits, work areas, and "toss zones" containing food debris, along with bone, stone, and shell artifacts. In the ensuing millennia, Eel Point witnessed substantial cultural and environmental changes (Garlinghouse 2000; Porcasi et al. 2000; Raab et al. 1994; Salls 1988),

Early to Middle Holocene coastlines experienced ongoing fluctuations in sea levels. Based on radiometric dating of drowned corals, sea level rose about one cm per year from about 16,000 to 6000 B.P. (Bard et al. 1990; Fairbanks 1989, 1990). Reconstructions of the Eel Point coastline at 9000 B.P. suggests the sea level was then about 32 m below its current stand, locating the Eel Point Site approximately 1 km farther inland than at present (Figure 3).

History of Investigation

The first recorded investigation of Eel Point was a brief excavation by Marshall McKusick and Claude Warren in 1958 (McKusick and Warren 1959). This work demonstrated abundant, well-preserved faunal remains and artifacts, but lacked the resources to probe the full extent of the site or to assess the

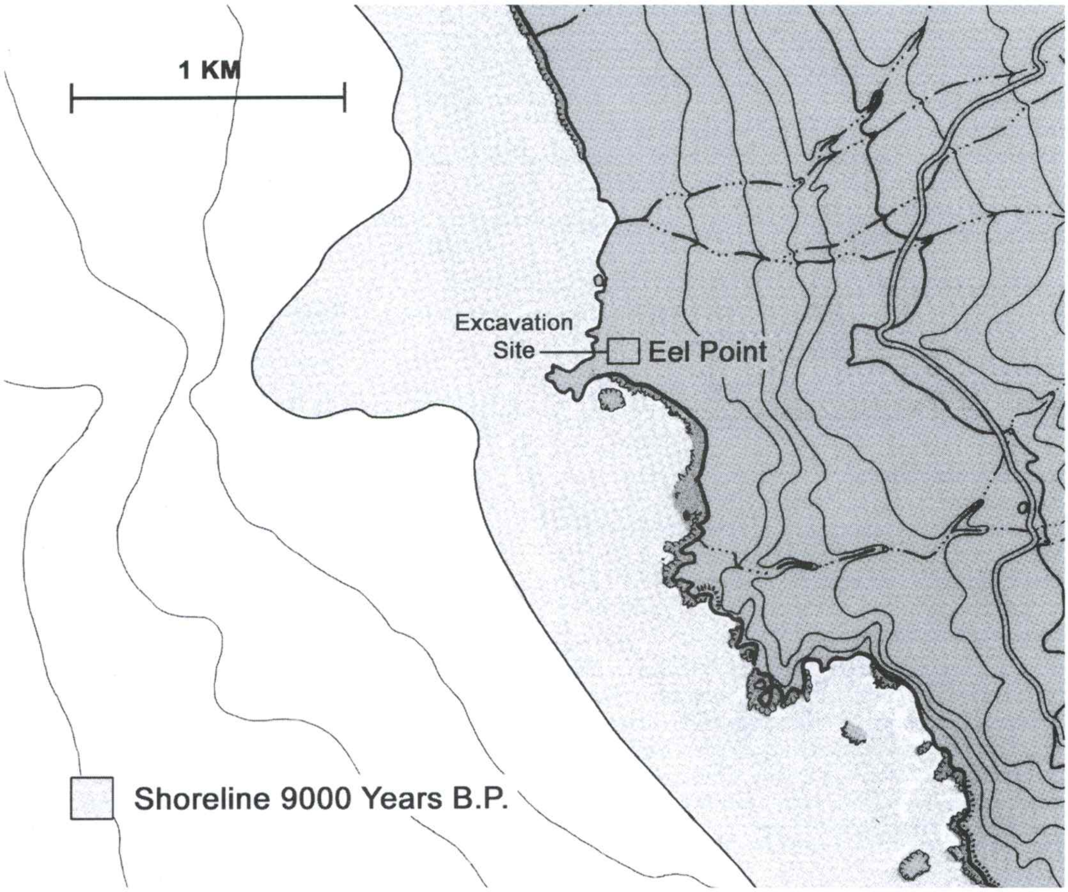

Figure 3. At 9000 B.P. the sea level was 32 m below present and the coastline at Eel Point (CA-SCLI-43), on San Clemente Island extended west slightly over 1 km from the site. The bathymetric contour lines represent 30-fathom (six feet per fathom) increments of ocean depth for the present sea level, and the terrestrial contour lines are in 100-foot increments.

age of Eel Point's cultural deposits. The site's Early Holocene cultural component was not recognized until two decades later, when a radiocarbon date (LJ-4130) of 8180 ± 110 B.P. was obtained (Salls 1988:359).

Further excavations at Eel Point have been conducted by Andrew Yatsko of the North Island Naval Air Station, and Mark Raab at California State University, Northridge (CSUN), since 1994. These efforts have resulted in discussions of site chronology (Raab et al. 1994), trans-Holocene sea-mammal hunting and fishing trends (Andrews 2000; Garlinghouse 2000; Porcasi and Fujita 2000; Porcasi et al. 2000; Raab, Porcasi, Bradford, and Yatsko 1995; Salls 1988; Vance 2000), stone tool assemblages (Cassidy 2000; Cassidy et al. 2000), and a description of prehistoric residential features (Fiore 1998).

Eel Point has revealed a comparatively long and detailed chronology of settlement, including a well-defined Early Holocene component. Since 1994, repeated sampling of the basal cultural stratum of Eel Point firmly establishes a mean date of initial occupation of about 8200 cal years B.P., based on the eleven radiocarbon dates shown in Table 1.

Early Holocene Settlement

The Early Holocene cultural deposits at Eel Point are covered by shell-bearing midden deposits, varying in thickness from about 1.5–3.5 m. This material ranges in age from about 6500 B.C. to European contact, with more than 80 percent of these deposits having accumulated since 1500 B.C. (Raab et al. 1994). To date, a total of about 5 m^3 of Early Holocene cultural deposits have been recovered from an exposed area of 23 m^2 (Figure 4). While

Table 1. Early Holocene Radiocarbon Dates from Eel Point (CA-SCLI-43), San Clemente Island.

Lab Number	Provenience	^{14}C Age[a]	δ^{13}C	^{13}C Adj.	Material	Cal Age B.C.[b]
Excavation Unit C						
Beta-75093	Stratum II	7490 ± 70	+0.7	7910 ± 70	Shell[c]	6080–6250 (6198)
Beta-76021	Stratum II	8120 ± 310	-25.3	8110 ± 300	Charcoal	6642–7521 (7076)
Excavation Unit F						
Beta-100567	Stratum II	7530 ± 80	+1.5	7960 ± 80	Shell	6156–6356 (6226)
Excavation Unit 2N/35E:						
Beta-76152	Stratum II	7720 ± 130	+0.5	8140 ± 130	Shell	6266–6555 (6418)
Excavation Unit 29N/15E						
Beta-133328	Stratum II	7690 ± 50	+0.9	8120 ± 50	Shell	6362–6445 (6404)
Beta-133329	Stratum II	8910 ± 70	-23.5	8940 ± 70	Charcoal	7968–8257 (8205)
Excavation Unit 29N/16E						
Beta-95897	Bead, Stratum II	7790 ± 60	+0.5	8210 ± 60	Shell	6416–6565 (6460)
Beta-95898	Stratum II	7150 ± 210	-24.0	7160 ± 210	Charcoal	5806–6226 (6014)
Beta-95899	Stratum II	7670 ± 90	+1.2	8110 ± 90	Shell	6296–6459 (6397)
Beta-133325	Stratum II	7440 ± 90	+1.2	7870 ± 90	Shell	6025–6231 (6156)
Excavation Unit 29/17E						
Beta-133327	Stratum II	7740 ± 30	+1.6	8180 ± 30	Shell	6411–6477 (6442)

[a]Radiocarbon years before present, uncorrected for fractionation in nature (δ^{13}C).

[b]Dendrocalibrated age of samples in years B.C. (present= A.D. 1950), with 1-σ age range and mean intercept in parenthesis, calculated by Calib rev. 4.1 (after Stuiver and Reimer 1993).

[c]All shell dates calibrated as follows: Calib rev. 4.1 marine reservoir corrected (ΔR) shell dates involve two components: (1) a time-dependent global ocean correction (402 years) incorporated into the program's marine calibration curve, and (2) a local ocean offset of 225 ± 35 years for southern California (Stuiver and Braziunas 1993:138; 155–156; see also Taylor 1987:129).

this is a comparatively small sample, the Early Holocene cultural component at Eel Point consists of a discrete stratigraphic unit (basal cultural stratum) deposited on thin, culturally sterile sediments covering bedrock.

Separating this component from later cultural deposits is a layer of reddish sand, virtually devoid of cultural material. This stratum marks a hiatus in the site's radiocarbon chronology of approximately 1,500 radiocarbon years. Dates below the red sand layer suggest a possible 300–500 year span of occupation. The stratum immediately above the red sand layer has an age of about 4400 B.C. (Raab et al. 1994). Largely sealed from later occupation of Eel Point, the site's basal stratum is one of the best-preserved Early Holocene cultural records examined to date in the Channel Islands.

Two relatively discrete occupational loci have been identified in the Early Holocene cultural deposits at Eel Point (Figure 4). Locus 1 revealed a low-lying arc of stones. This feature appears to continue into the surrounding cultural deposits, perhaps forming a larger ring of stones with a diameter of about 5 m. This structure may have served as a low wall or foundation of a windbreak constructed by piling up natural stones. Inside this ring was a shallow pit containing faunal remains and natural stones. Nearby features and artifacts reinforce the residential character of Locus 1. Immediately to the south of the ring were two overlapping shallow hearths surrounded by 10-cm-thick deposits of ash, burned shell fragments, and faunal remains.

Numerous artifacts were found in these deposits, including six mussel shell disc beads. One of these beads produced an AMS date of 6460 cal B.C. (Beta-95897). Shell and charcoal samples from one of these hearths returned dates of 6014 cal B.C. (Beta-95898) and 6397 cal B.C. (Beta-95899), respectively. A charcoal sample from within the stone arc also produced a date of 6156 cal B.C. (Beta-133325). Locus 1 also produced a charcoal date of 8205 cal B.C. (Beta-133329). At present, we are not convinced this date accurately reflects

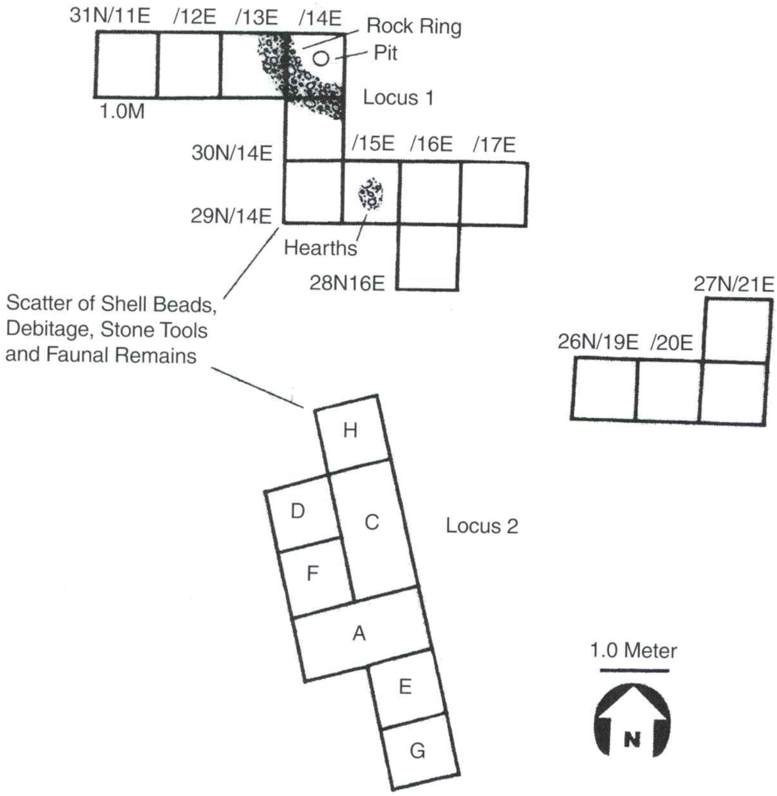

Figure 4. Location of excavated areas in the Eel Point site and unit layout identifying locus 1 and locus 2. Features are identified as rock ring, hearth and pit.

the initial settlement of Eel Point. We have excluded this date and the 8205 cal B.C. date (Beta-133329), from the present analysis because they fall well outside the range of variation of the other dates in Table 1.

In Locus 1, a metate fragment and mano, formed on a natural volcanic stone slab and beach cobble, along with other flaked and ground-stone tools and tool-working debris, were recovered around the hearths described above, as well as inside the rock ring feature. Faunal remains of sea lions (*Zalophus californianus*), harbor seals (*Phosa vitulanius*), and dolphin of various species collected from these contexts attest to the importance of sea-mammal hunting and shellfish collecting as major economic pursuits, supplemented by fishing (Garlinghouse 2000; Porcasi et al. 2000; Raab, Porcasi, Bradford, and Yatsko 1995). These patterns appear to establish Locus 1 as a focal point of domestic activities, centering perhaps on a residential structure of some kind.

At Locus 2, a somewhat less-discrete concentration of domestic features, artifacts, and faunal remains were found about 9 m south of Locus 1. This area revealed a hard-packed surface containing at least one posthole feature. Three samples of shell in direct contact with this surface produced ages of 6198 cal B.C. (Beta-75093) and 6226 cal B.C. (Beta-100567). A charcoal sample from the same surface yielded a date of 7076 cal B.C. (Beta-76021). A mussel shell bead was recovered from this surface as well, identical to specimens recovered from Locus 1. Like Locus 1, this area yielded chipped and ground stone tools and faunal remains. Thus, it appears that two adjacent Early Holocene domestic loci were occupied very close to one another in time, if not contemporaneously.

Based on the observed cultural features and deposits of artifacts, the Early Holocene cultural component at Eel Point reflects a substantial degree of residential permanence. The deposits of tools, food remains and related features, including hearths and possibly a habitation structure, appear to reflect the sort of "planning depth" that Binford (1980,

1990) associates with the residential bases of logistically organized "collectors." Given the use of watercraft by San Clemente Island's occupants, this type of settlement is perhaps not surprising. Watercraft may have encouraged collector-style behavior, where boats capable of hauling heavy loads over considerable distances allowed sea mammals and other bulky food items to be transported to residential bases for processing. The ability of boats to concentrate bulky resources drawn from a wide geographic area would seem to work against "forager" settlement-subsistence tactics in which resource access is achieved essentially by moving people and their camps to the relevant resource locations. Occupied or re-occupied over substantial periods of time, residential bases serviced by watercraft may have attracted labor investment in habitation structures, creation of spatially discreet work and refuse disposal areas, and other signs of planning depth. As Ames (2002:34) points out, the implications of watercraft for shaping settlement-subsistence patterns have probably been underestimated by archaeologists. This is an area of research that deserves greater attention.

Eel Point Lithic Technology

Stone Tool Assemblage Diversity

The Early Holocene stone tool assemblage at Eel Point offers considerable insight into the techno-economic capabilities of the site's residents. Cassidy (2000) studied trans-Holocene patterns of tool use, identifying 24 stone tool types employed during the entire span of site occupation. Utilizing a radiocarbon-based site chronology (Raab et al. 1994), these tools were assigned to four time periods: Early Holocene (ca. 6558–5958 B.C.), Middle Holocene (ca. 4400–3500 B.C.), Late-Middle Holocene (ca. 2600–1500 B.C.), and Late Holocene (ca. 1500 B.C. to Spanish contact). The classification of the Eel Point tools, shown in Table 2, illustrates some broad patterns of tool use across time.

Turning to a more detailed study of the Early Holocene cultural component, the key challenge was to accurately identify the tools' technological and functional attributes, prompting a three-step analytical process. First, gross morphological inspection was made of the tool assemblage from Eel Point, characterizing techniques of tool manufacture and patterns of damage or wear. Although this step led to hypotheses about tool use, we recognized that functional interpretations based solely on gross morphological characteristics are often misleading (Arnold 1992; Binford 1973; Binford and Binford 1966).

The functional diversity of the Early Holocene tools include multidirectional cores, unidirectional cores, microlithic cores, a burin, a chopper, a hammerstone, a pitted-anvilstone, a mano, a metate fragment, sandstone abraders, scraper-planes, retouched flakes, a wedge, drills, two types of reamers, and tar applicators. This assemblage was supplemented with a pinniped rib bone that exhibited a blunted work end and asphalt smears. An inspection of Table 2 reveals some interesting differences between the Early Holocene and later occupations. First, the microcores, burin, sandstone abraders, scraper-planes, and the wedge only occur in the Early Holocene.

Second, bifacial points are found in the three later periods, but not in the Early Holocene component. While the total counts of lithic artifacts found in the Early Holocene deposits may give the impression of being relatively sparse, when compared on a volumetric basis, they were equal to the volume of tools in the site's Middle Holocene cultural component, approximately one-half of the tools found in the Late/Middle period, and about two-thirds of the tools of the Late period occupation. An analysis of these differences would take us beyond the scope of the present discussion. However, it appears worth noting that maritime economic patterns shifted markedly across the Holocene at Eel Point. Comparatively large sea mammals (seals, sea lions, and dolphins) and California mussels (*Mytilus californianus*) provided most of the food during the Early Holocene, while fish made only an incidental contribution. By the Late Holocene, small shellfish (*Tegula sp.*, or black turban snail), sea otters (*Enhydris lutra*), and particularly fish contributed the bulk of the marine diet (Garlinghouse 2000; Porcasi et al. 2000). Several studies show that heavy reliance on fishing developed at Eel Point only after the Middle Holocene, reaching particularly high levels in the millennium or so prior to European contact (Andrews 2000; Garlinghouse 2000; Porcasi et al. 2000; Raab et al. 1994; Raab, Bradford, Porcasi, and Howard 1995).

Table 2. Eel Point (CA-SCLI-43) Lithic Artifacts by Type, Period, and Volume.

Tool Types	Early Holocene 6558–5958 B.C.	Middle Holocene 4400–3500 B.C.	Late/Middle Holocene 2600–1500 B.C.	Late Holocene 1500–Historic	Totals
Core/multidirectional	4	12	42	45	103
Core/unidirectional	11	20	6	46	83
Core/boat-shaped	0	2	2	1	5
Core/microlithic	5	0	0	0	5
Burin	1	0	0	0	1
Chopper	1	1	3	7	12
Hammerstone	1	15	20	35	71
Pitted-Anvilstone	1	15	17	20	53
Manos	1	13	16	24	54
Metates	1	8	3	20	32
Pestles	0	1	2	8	11
Mortars	0	0	0	8	8
Undiff. Groundstone	1	2	8	29	40
Comals	0	0	1	3	4
Sandstone Abraiders	3	0	0	0	3
Scraper-Planes	2	0	0	1	3
Retouched Flakes	2	12	11	8	33
Wedge	1	0	0	0	1
Bifacial Notched	0	0	1	0	1
Bifacial Point	0	5	3	11	19
Drills	2	1	1	4	8
Reamers	5	2	1	0	8
Tarring Pebbles	0	0	66	13	79
Tar-Smeared Pebbles	2	0	1	2	5
Totals	44	109	204	285	642
Eel Point Lithic Artifact Counts Per Cubic Meter					
Totals	11.87	11.70	21.40	15.86	61.03

The presence of a mano and a metate fragment implies the possible processing of plant materials such as grass seeds. San Clemente is a desert island with few reliable year-round sources of freshwater. Potential consumable plant resources on the island, other than grass seeds, include the blue-dick tuber and a few oak trees on the eastern escarpment. Exploitation of the blue-dick tuber on San Clemente is attested to by presence of numerous donut stones, or digging stick weights, scattered over the island landscape. The only source of wood on the island, other than the few scattered oak trees, is driftwood that washes onto the western beaches.

The only land mammal known to have inhabited the island is the diminutive island fox, which may have been introduced by later inhabitants (Raab et al. 1994). Processing of terrestrial resources in this highly depauperate insular location must have been minimal, thus affording an exceptional opportunity to evaluate heavily marine techno-economic patterns (Fitzhugh and Hunt 1997).

Drills were recognizable by symmetrical patterns of wear created by tool rotation particularly seen through damage to the drill tips and lateral edges. Based on specimens observed thus far, drills were fashioned from retouched flakes (Figure 5A).

Reamers were used to expand or smooth an existing depression or perforation, rather than to drill a perforation. Two types of reaming tools were identified. One of these tool types, for want of a better name, might be described as a "blunt-nose" reamer. The specimen shown in Figure 5B was formed from an elongated natural pebble, thinned at one end by removal of two flakes, presumably to facilitate hafting. The working end reveals two distinctly different types of use-wear patterns. This tool could never have been effective as a drill because of its rounded tip. It is stained with ochre and appears to have been employed to grind or apply red pigment.

It appears that these reaming tools were used under high torque as they frequently broke during use, as illustrated by numerous reamer tip fragments

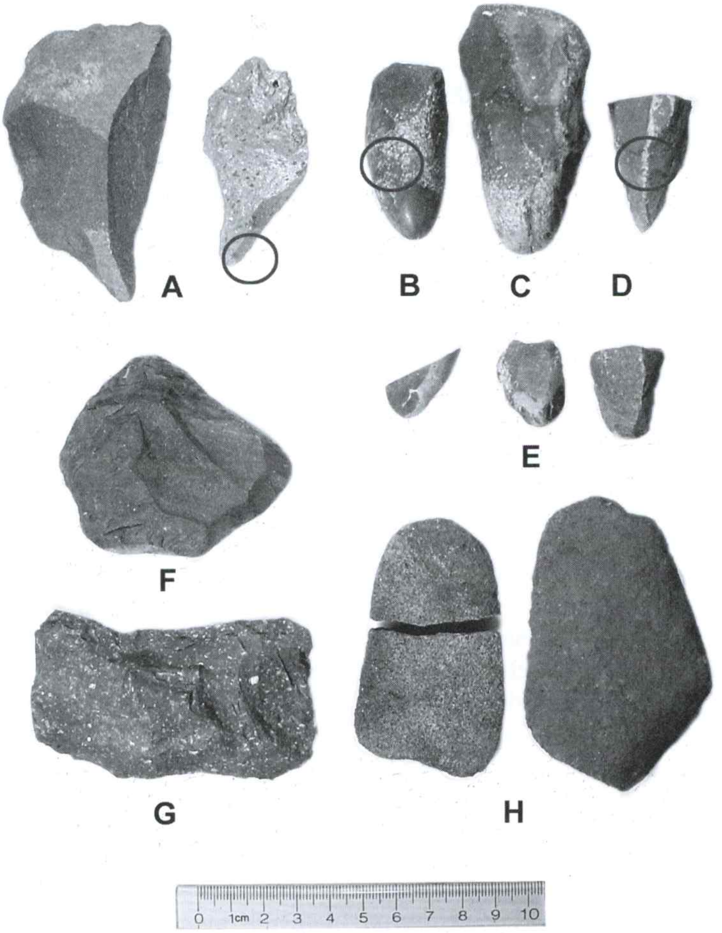

Figure 5. Selected tools from the Early Holocene component at Eel Point include: (A) two flake drills (unit H, level 4), (B) hafted blunt-nosed reamer (unit H, level 4), (C) hand-held blunt-nosed reamer (from unit 31N14E, level 3), (D) triangular pointed reamer (31N14E, level 4), (E) three broken reamer tips (29N17E, level 4; 31N14E, level 4; and 31N14E, level 3 respectively), (F) wedge (unit H, level 4), (G) scraper plane (29N15E, level 4), (H) sandstone abraders (unit H, level 4). The circled areas on tools A-right, B and D correspond to the locations where microphotos were taken in Figure 7B, 7C and 7E respectively.

found in the site (Figure 5E). A high degree of abrasion on the reamer edges suggests use under heavy loads and on relatively hard materials. Some reamers appear to have been employed in a haft (Figure 5B); others appear to have been held in the hand (Figure 5C).

The second type of reamer can be described as a "triangular-pointed" variety (Figure 5D) that is morphologically similar to the Chumash "canoe drill" (Gamble 2002). The distal end of this reamer was flaked to produce a pointed tool with a triangular cross-section. Examination of the wear patterns on the triangular-pointed reamer reveals heavy abrasion of the tool's lateral edges but virtually no damage to the tip. This tool was clearly employed to expand an existing work orifice, rather than create an initial perforation.

One of the most remarkable tools found in the Early Holocene component at Eel Point is the stone wedge (Figure 5F). Formed on a stout retouched flake of rhyodacite, the polished high points on both faces of the tool show where it entered a comparatively soft material, almost certainly wood. On the end of the wedge opposite the cutting edge are crushing, pitting, and step fractures that resulted from blows required to drive it into a work piece.

Other tools appear well suited to shaping and finishing work pieces of wood, bone, and perhaps other materials. Figure 5G shows a large flake that was trimmed around the margins to produce a

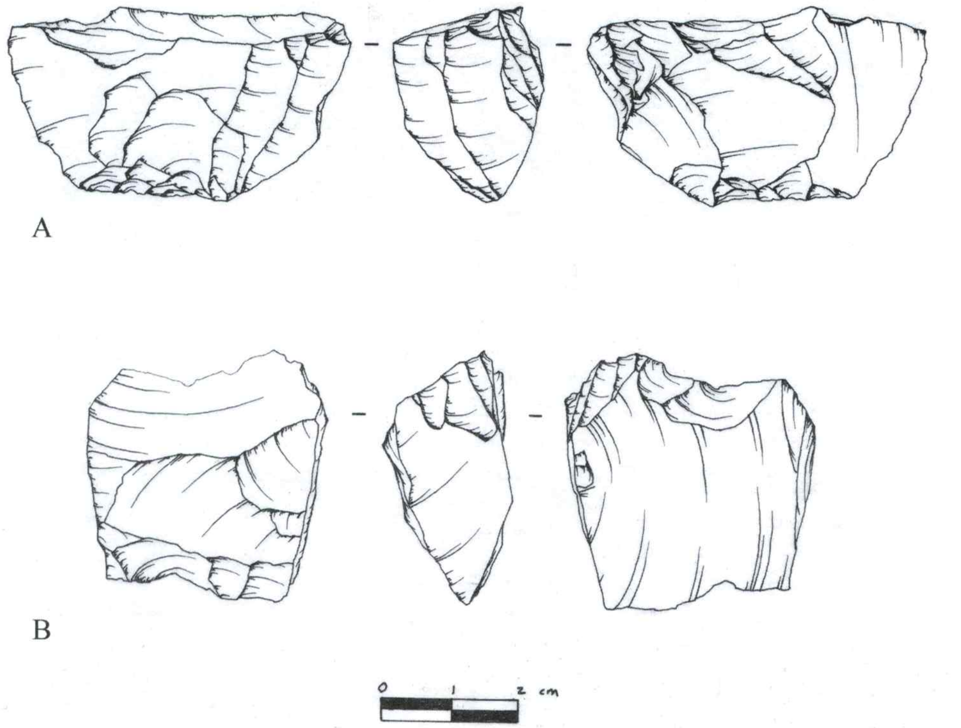

Figure 6. Selected microcores from the Early Holocene component at Eel Point include: (A) wedge shaped microcore (unit 28N, auger sample at 120 cm), (B) blocky flake microcore (28/29N16E, level 4) (drawn by Jason Toohey).

rectangular tool. This tool exhibits heavy, bifacial wear on the long edges, consistent with use as a planing device, probably for shaping wood.

Sandstone abraders, a material that had to be imported to San Clemente Island, are shown in Figure 5H. Tools of this kind would have been ideal for smoothing and shaping relatively soft materials such as wood and bone, and appear to have been discarded once they became smaller than the palm of a hand.

The assemblage at Eel Point also contains what appear to be microlithic tools. Five non-prismatic microcores have been identified to date from the Early Holocene component at Eel Point. Although this sample is small, it should be recognized that the techniques involved in microcore and blade production are as distinctive and purposive as bifacial core-reduction techniques (Chun and Xiang-Qian 1989; Imamura 1996). The Eel Point microcores were manufactured from relatively small, blocky flakes. Characteristically, a top-spall was removed to create a platform suitable for flake removals along the oblique face of the core. Evidence of retouch to the platform in preparation for subsequent flake removals is also present (Figure 6A and 6B).

These cores appear to be technologically analogous to those found on the Northwest Coast in Early Holocene deposits (Ackerman 1996; Ames and Maschner 1999; Davis 1996; Dixon 1999), and in the Far East (Imamura 1996:37). However, the poor quality of the rhyodacite material available on San Clemente Island appears to have prohibited the development of truly prismatic blade cores. A burin was also found among the Early Holocene tools at Eel Point (also from unit H, level 4). Microscopic wear on the burin (discussed further below) suggests its use in cutting grooves into wood. This is an essential requirement for the insertion of microblades into haftings for the fabrication of composite cutting tools or projectiles. An examination of the stone flakes from these deposits revealed that approximately 10 percent were blade-like in character (linear flakes less than 5 cm in length and at least twice as long as they were wide).

Analytic Techniques

Tools that exhibited a cutting edge or work surface were examined with a low-power microscope (10-50x) for use-wear damage (Odell and Odell-Vereechen 1980). Evidence of use wear resulted in the selection of the burin, scraper-planes, wedge, drills, and reamers for further analysis employing an Olympic incident-light high-magnification microscope (100–200x), following established procedures (Keely 1980; Semenov 1964). Nina Kononenko, who was trained by Sergei Semenov as a lithic specialist, and has studied the methods of microscopic use-wear analysis devised by North American specialists, conducted the microscopic examination of the Eel Point tools (Cassidy et al. 2000).

As a result of preliminary observations of the archaeological tools, replicas were manufactured and then used to work both wood and stone. The tools were replicated from volcanic (rhyodacite) beach cobbles available near the site, which were the overwhelmingly favored raw material employed at Eel Point throughout all periods of occupation.

Examination of the use-wear surfaces on the archaeological tools through the application of high-power microscopic techniques revealed the formation of relatively smooth polishes on the topographic high points, with invasive striations in parallel formations. This suggests that the tools were used on wood surfaces (Vaughan 1985:33). The sides of the reamers also exhibited heavy parallel striations, but an absence of polish formation, suggesting use on a highly abrasive material such as stone.

A replicated tool was used to drill a hole into wood. Next, a replicated reaming device, with a rounded distal end, was employed to widen the hole. These experiments resulted in the accumulation of high luster use-wear polish that spread across the utilized edges and into depressions in a diffuse pattern (Figure 7A). An examination of the archaeological drills revealed similar bright and smooth polish consistent with woodworking (Figure 7B). This type of polish was also consistent with use wear present on the archaeological wedge, scraper-plane, and burin.

An experiment employing sand as an abrasive, while reaming wood resulted in the formation of parallel grooves that were interspersed with bands of polish (Vaughan 1985:38). An examination of the side of the archaeological blunt-nosed reamer that exhibited ochre stains revealed similar, although less invasive, patterns of striations and polish (Figure 7C). This suggests the grinding of a mildly abrasive substance, such as ochre, while using a soft platform, such as wood.

To differentiate stone- and wood-induced wear, a hole was pecked into a basalt cobble and a replicated reamer was employed to widen and smooth the hole. The experimental reamer exhibited substantial abrasive use wear and parallel striations, but little polish formation (Figure 7D). This pattern is similar to the use wear on the blunt-nose and pointed triangular reamers from the archaeological assemblage (Figure 7E).

Breaking Free of Traditional Models

Biface Bias

From the inception of American archaeology, researchers have tended to view certain kinds of stone tools and weapons as centrally important to characterizing foraging adaptations (Steffen et al. 1999:133). Bifacial stone tools and their use for terrestrial hunting thus become proxies of cultural "sophistication." Tool assemblages lacking in these forms, particularly bifacial projectile points, may be dismissed as expedient: suitable only for technologically undemanding tasks by peoples bearing relatively "unsophisticated" cultural adaptations (Binford 1979). There are good reasons to reject such impressions, since rigid distinctions between curated and expedient technologies may serve to mask complexity and functional diversity:

> Although archaeologists are well-supplied with descriptions of many important aspects of tool production and use, particularly manufacturing procedures, it is relatively rare for our analyses to move from these descriptions to explanations of them. The notion of curation is frequently encountered in the literature, and yet adds few real insights to most discussions. Classifying a collection of tools as "curated" or "expedient" is an oversimplification and in itself tells us very little [Bamforth 1986:49].

As noted above, excavations at Eel Point have thus far produced no projectile points from an Early Holocene context, and only a handful of bifacial projectile points from Middle and Late Holocene

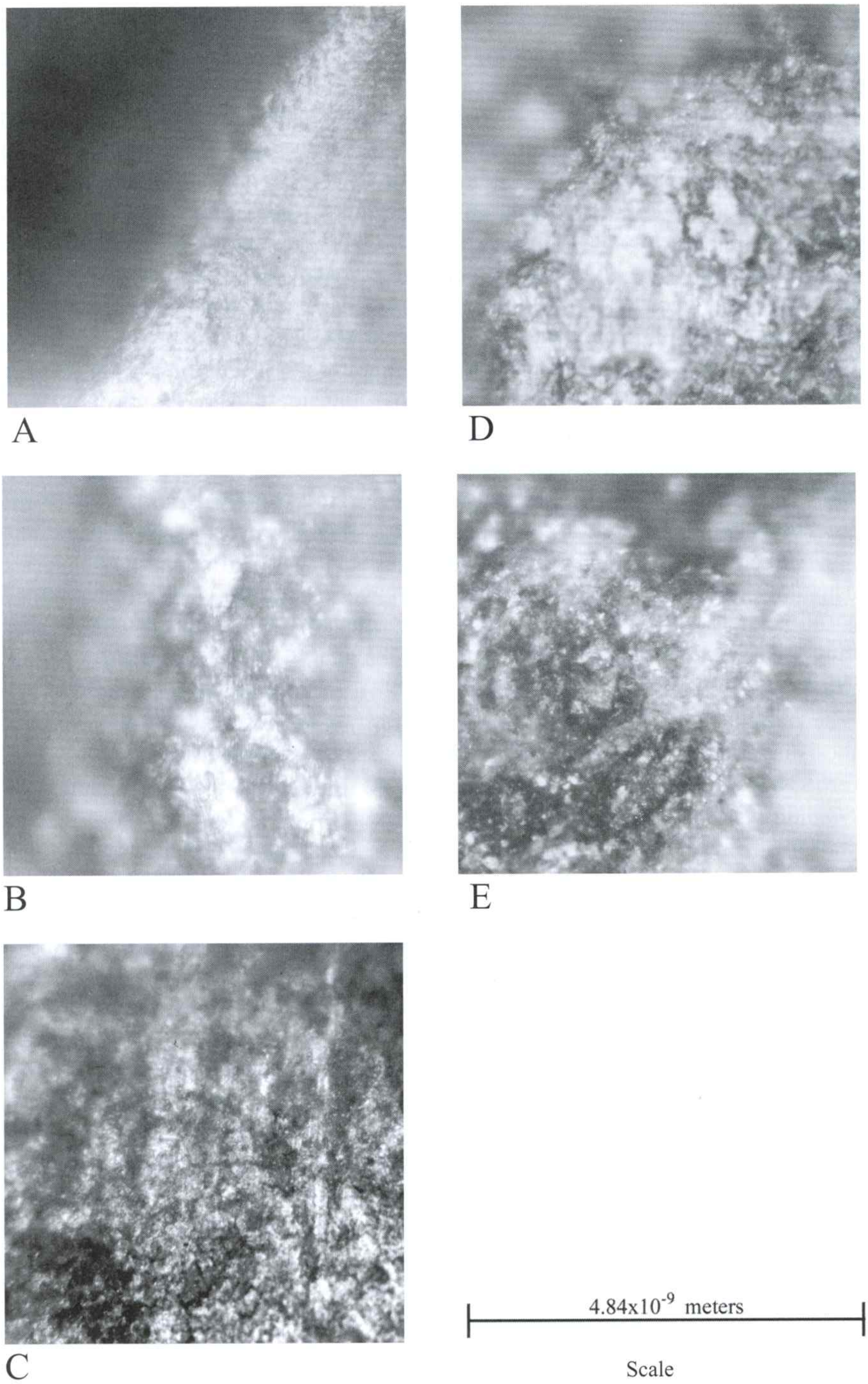

Figure 7. Selected archaeological tools were examined for use-wear traces under a high magnification incident light microscope and compared with experimental tools. Microphotos of the results were produced at 200× resolution. Microphoto 7A is of an experimental drill used on pinewood for a period of 30 minutes and is comparable to microphoto 7B that exhibits a highly lustrous polish (see circled area in figure 5A-right drill for location). Microphoto 7C is from the side of the archaeological hafted blunt-nosed reamer (see circled area in figure 5B for location) and reveals low luster polish with striations, characteristic of use-wear from granular material such as ochre. Microphoto 7D is of an experimental reamer used on basalt for a period of 15 minutes and is comparable to microphoto 7Ethat was taken from the side of the archaeological triangular-pointed reamer (see circled area in Figure 5D) and exhibits a low-luster abraded surface.

times. Many coastal localities appear to reflect this basic pattern, including the Paleoarctic tradition of the Northwest Coast where marine-adapted microblade technology precedes the introduction of bifacial tools (Crowell 1999; Matson and Coupland 1995). While bifacial tools can scarcely be described as nonexistent in California coastal sites (Erlandson 1994; Gallegos 1991; Gallegos and Masters 1997; Glassow 1996, 2000; Meighan 1959), such tools often are lacking or occur in low frequency. Compared to the intensity with which archaeologists have studied the technological correlates of terrestrial hunting, maritime technological traditions remain comparatively little analyzed and reported. As we shall see, the resultant "biface bias" provides little basis for understanding Eel Point's distinctive technological and economic patterns, and how effective such strategies may have been for sustaining early coastal settlement.

Stealth Technology

The techno-economic patterns observed at Eel Point could be viewed in terms of two hypotheses. One hypothesis is that bifacial tools simply were not central to Eel Point's distinctively maritime patterns of hunting and gathering. As noted, sea mammals and shellfish were the mainstays of the Early Holocene diet (Garlinghouse 2000; Porcasi and Fujita 2000; Porcasi et al. 2000). With adult body weights of 70 to more than 200 kg, and calorie-rich blubber, seals, sea lions and dolphins represent impressive "meat packages." Significantly, pinniped remains are overwhelmingly of females and pups (70 to 90 percent), clearly indicating attacks on shore-bound breeding colonies. This type of hunting can be extremely effective with only the simplest of weapons, such as clubs (Porcasi et al. 2000). Evidence points to increasing trans-Holocene pressure on pinniped rookeries in both the northern and southern Channel Islands. These data reflect a pattern in which initial shore-based attacks gave way to hunting in some locations with boats, harpoons, and other complex equipment during the Late Holocene, when heavy hunting pressure decimated the most easily exploited pinniped breeding areas (Hildebrandt and Jones 1992; Porcasi et al. 2000; Walker et al. 2000).

Recent research reveals small cetaceans (dolphins) as a significant target of maritime hunting at Eel Point and other localities. Dolphins can be taken with astonishingly simple but effective hunting techniques. It seems that echo-locating dolphins (and other cetaceans) are fatally vulnerable to manipulation by sounds introduced into the water. Such techniques are documented in Japan and Oceania (Porcasi and Fujita 2000). In the Solomon Islands, for example, hunters in boats were photographed striking stones together under water, using the resulting sounds to drive dolphins into shallow water, where these animals were simply grabbed by hand, pulled into boats, or dragged ashore (Porcasi and Fujita 2000).

Despite these intriguing findings, it seems prudent to leave open questions pertaining to technological alternatives for sea-mammal hunting at Early Holocene Eel Point. For example, Late Holocene Northwest Coast groups and the Chumash Indians of the Northern Channel Islands were known to hunt sea mammals from boats with the use of harpoons. The fact that harpoon gear has yet to be identified in Eel Point Early Holocene cultural deposits does not necessarily rule out the possibility of such technology, given the small sample of the site's midden deposits (< one percent) excavated to date. Yet another technological tradition, microlithic technology, may have had a more extensive geographic distribution on the North American Pacific Coast during the Early Holocene than has been previously recognized, including Eel Point and perhaps other California coastal locations. Such technology, as elsewhere, may have represented an alternative to bifacial tools or the types of harpoon gear utilized in Late Holocene contexts. Production of microblades for slotted bone or wood implements yields considerably different patterns than archaeologists are accustomed to finding in contexts containing bifacial stone projectile points, bone harpoon points, and related gear. While tools utilized in the production of hunting implements, such as microblade cores, discarded microblades, and burins may be expected to be found in work areas where production activities took place, the end product of slotted hafting devices and usable microblades may well have been removed to locations where hunting activities were carried out. Patterns of this type, among groups who employed microblade technology, have been identified for Mesolithic Europe (Fisher 2002).

Whatever the ultimate fate of these hypotheses, Eel Point suggests a broader range of adaptive

possibilities than many archaeologists have come to expect. The presence of bifacial stone projectile points generally signals hunting activities, even in the absence of faunal remains. Yet the lack of such implements at Eel Point clearly is not correlated with the absence of hunting. The most effective weapons of these early maritime hunters may have been their shrewd knowledge of the behavioral vulnerabilities of dolphins and pinnipeds—knowledge likely developed independently by hunters in many coastal regions of the world. It appears to have been these "stealth weapons," invisible to archaeologists seeking the technological correlates typically associated with terrestrial hunting, that made surprisingly productive such an ostensibly remote and unpromising location as Eel Point.

Seafaring

Archaeologists have long appreciated the necessity of watercraft in Channel Islands settlement, taking particular note of the Chumash Indian *tomol*, a plank canoe used for this purpose (Arnold 2001; Gamble 2002). These discussions concern themselves primarily with arguments linking the appearance of the *tomol* to the emergence of social complexity among the Chumash, and how deep in time we can recognize the appearance of this type of watercraft. If the first appearance of social complexity and seagoing canoes were linked, one might conclude that significant seafaring capabilities were a relatively late development in the prehistory of the Channel Islands region. This impression is reinforced by Arnold (2001:14), for example, when she argues that the *tomol* evolved from earlier, more primitive types of boats and that the "plank canoe was likely not fully refined and reliably seaworthy until the A.D. 800-1000 era." In general agreement with the notion that *tomols* played an important part in the rise of social complexity, Gamble (2002) argues that *tomols* appeared at least a millennium earlier than Arnold's reconstruction, based on the appearance of triangular "canoe drills," some dating perhaps to the late Middle Holocene, as markers of the "origin" of plank-canoe construction.

While Arnold (2001:14) is correct in describing the *tomol* as a remarkable technological achievement, should we conclude that it was the first and only "fully refined and reliably seaworthy" type of watercraft to appear in the Channel Islands during their long occupation? The technological and economic evidence discussed earlier cautions against this conclusion.

Like Gamble (2002), we have examined Middle Holocene triangular canoe drills under a high-power microscope and can confirm that they exhibit high-luster wood polish. In this regard, there is no argument that these tools could have functioned as plank drills in the construction of *tomols*. However, as shown above, triangular reamers were used at Eel Point during the Early Holocene, indicating that this general tool form is much older in Southern California coastal assemblages than previously recognized. Also, the flake drills found in the Early Holocene layer at Eel Point (Figure 5A) are approximately the same size as the Late Holocene canoe drills. Further, ethnographic accounts of historic *tomol* construction do not refer to the use of triangular (or any other type of) "canoe drill." Instead, J. P. Harrington's notes describe how holes were burned and gouged into planks during the construction of a Chumash *tomol* (Hudson et al. 1978). Based on this evidence, it appears that differing methods could have been used to perforate planks or other watercraft components.

Of course, the *tomol* can play a useful role in understanding early Channel Islands seafaring. As we noted earlier, it seems reasonable to hypothesize that deep-water voyaging always exerted a strong selective influence on boat design and construction. As one type of watercraft used for Channel Islands voyages, the Chumash *tomol* (and the similar Gabrielino Indian *ti-at*) offers a point of reference for assessing possible boat design and construction modes. The V-shaped hull of the *tomol*, typically 6–7 m long and capable by some estimates of carrying more than a ton of cargo, was formed by perforating and lashing together split wooden planks, sealed with asphalt (Arnold 2001:13-15). Operated without sails, this craft was powered by paddles and required a minimum crew of two. J. P. Harrington, noted California ethnohistorian, collected detailed information on *tomol* construction from Chumash Indian boat wrights during the early twentieth century. Hudson et al. (1978:21-53), drawing on Harrington's notes, identified the following materials and tools involved in *tomol* building: asphalt as a watertight adhesive and sealant; driftwood, especially straight-grained species such as redwood or cedar; wedges from stone, wood, bone, or antler for splitting planks; fibrous plant

material for making cordage; caulking chisels made from wood or bone; ochre to mark lines and color exterior coatings; shell or stone chisels; stone flakes for cutting and shaving wood; pointed flakes for gouging holes into wood; stone or shell scraper planes; and sandstone and sharkskin abraders.

This list is strikingly similar to the Eel Point tool assemblage described earlier. While there can be little doubt that driftwood and cordage were used at Eel Point, we find direct evidence of asphalt, ochre, stone flakes suitable for gouging and cutting wood, drills, stone scraper-planes, a sea-mammal rib with a blunted work end and asphalt smears suitable for use as a caulking chisel, asphalt-smeared slabs of stone, sandstone abraders, reamers and wedges (Cassidy et al. 2000). The reamers, microcores, and burin noted earlier add additional dimensions to the tool assemblage.

The functional characteristics of these woodworking tools are also informative. Clearly they could have been, and probably were, employed in a number of different woodworking activities other than the construction and maintenance of watercraft. The full extent of these activities, such as the construction of shelters, will never be known since they have not survived in the archaeological record. What we can infer from the tools, however, is that the splitting of planks was accomplished through pounding the wedge into large pieces of wood, probably driftwood. We can also infer that the edges of these planks were probably then smoothed with the scraper planes and this procedure would be consistent with the joining of pieces together into composite structures. The presence of numerous sandstone abraders also attests to smoothing and joining activities for planks. Further, the flake drills found in the deposits were of sufficient size and strength to perforate planks and allow them to be lashed together to form composite constructions.

In making the comparison between Chumash boatbuilding and the Eel Point technological profile, we are not suggesting that *tomols* were constructed at Eel Point. *Tomol* construction is considered here only for the purpose of making a comparative assessment of technological capabilities. Once again, given the odds against archaeological recovery of Early Holocene watercraft, comparative analysis of maritime technological capabilities across time may be one of the most productive strategies available to us for understanding the origins and development of seafaring. Based on such a comparison, it appears that Early Holocene Eel Point reflects technological capabilities similar to those of the historic Chumash. Based on these similarities, and the importance of boats in the settlement of insular localities, it seems probable that boatbuilding and/or maintenance are likely activities reflected in Eel Point's Early Holocene tool assemblage. Contrary to scenarios that envision sophisticated seafaring capabilities as a Middle or Late Holocene development, it appears that such voyages were well within the technological grasp of Early Holocene mariners.

Discussion and Conclusions

The Eel Point data underscore continuing problem areas in the study of maritime cultural origins. There is still a tendency to characterize early coastal adaptations as technologically complacent, vis-à-vis terrestrial foraging:

> Temperate coastal technological adaptations rely heavily on readily available materials such as driftwood, marine mammal products, beach cobbles, and shell, which in many cases may have been partially modified by noncultural processes. In such an environment, reliance on sophisticated lithic technologies was probably not as important as in other environments [Dixon 1999:249].

Dixon (1999:249) goes on to argue that temperate coastal locations may have "de-emphasized the production and use of bifacially flaked lithic tools and placed greater reliance on simple flakes and organic materials." These descriptions bear a striking similarity to the situation at Eel Point. Yet, the Eel Point case warns against concluding that this implies a limited techno-economic capability or a limited ability to colonize challenging environments.

Archaeologists are just beginning to understand the selective forces behind early maritime cultural adaptations, particularly in temperate coastal regions. As Kelly (1995:71–73) points out, the factors responsible for the emergence of maritime foraging on mid-latitude coastlines are more difficult to explain than in cases where a strong differential in subsistence productivity obviously favors the marine environment over contiguous terrestrial settings. At high latitudes, for example, low winter temperatures promote such a differential, while

desert coastlines can create a similar advantage. But what explains the appearance of maritime foraging in temperate regions characterized by much less extreme terrestrial environments?

Jones (1991, 1992), for instance, shows that Southern California was the first section of the state's 1,200-km coastline to be settled—an occupation that commenced, as we have seen, at least as early as 10,000 B.C. The southern region's comparatively xeric environment and scarcity of large terrestrial mammals are cited as factors that may have encouraged early reliance on marine food resources. "In comparison to the terrestrial habitat, offshore and littoral environments of Southern California are richer and more diverse" (Jones 1991:428). Advocates of optimization models stress that human predators are likely to occupy available environments that offer the greatest cost/benefit returns (Broughton and O'Connell 1999).

It seems increasingly clear that even temperate, mid-latitude regions such as Southern California provided opportunities that favored maritime foraging from early time periods. Eel Point contradicts the a priori assumption that early maritime foraging was unsophisticated techno-economically, and we can infer that it was at least as economically productive as contemporaneous terrestrial foraging adaptations.

While archaeologists recognize that huge variation existed in the form and function of the bifacial tool assemblages used in terrestrial environments, understanding assemblage variation in maritime-oriented tools, including non-bifacial forms, is equally important. While we emphasize again that the Eel Point tools described here could have been used for many purposes, the basic technological similarities of tool forms observed at Early Holocene Eel Point and tools used by Late Holocene boatbuilding groups such as the Chumash are striking. In our view, these similarities make it difficult to assert that the region's early maritime technological traditions were primitive or that sophisticated seafaring traditions arose only through a process involving gradual trans-Holocene refinements. On the contrary, Eel Point suggests that life on the waters of the North American Pacific coast may have exerted selective pressures in favor of complex technological capabilities as far back in time as the appearance of the region's first seafaring peoples.

Our understanding of early maritime economy continues to expand and may surprise us with its range of variation. Early coastal populations of Southern California and the Channel Islands clearly were utilizing a wide range of marine resources, including fish, shellfish, sea mammals and, where available, terrestrial plant foods (Erlandson 1994; Erlandson et al. 1999; Glassow 1996). Yet popular impressions of prehistoric economy in the Channel Islands, based mainly on the analysis of Late Holocene cultural deposits, give primary importance to fishing and shellfish collecting, supplemented by sea-mammal hunting (Chartkoff and Chartkoff 1984; Moratto 1984). A nearly opposite picture emerges from Early Holocene Eel Point. Sea mammals appear to have contributed most of the calories to the Early Holocene diet at Eel Point, supplemented by shellfish collecting and fishing. Eel Point's Early Holocene inhabitants can be described more accurately as maritime hunter-collectors than fishers. While we have not undertaken detailed comparisons, pinniped and dolphin hunting at Eel Point during the Early Holocene probably compared favorably with the pursuit of medium- to large-size terrestrial animals in contemporaneous mainland settings, in terms of prey size and nutritional yield (Garlinghouse 2000; Porcasi et al. 2000).

The presence of a microblade tradition at Eel Point during the Early Holocene is worth emphasizing: its benefits have been identified through previous work in Europe and Asia (Fisher 2002; Imamura 1996; Jochim 1998). Microlithic technology affords lightweight, easily maintainable tools and weapons to peoples who had limited access to high-quality lithic raw materials, owing to high mobility, resource scarcity, or a combination of such constraints (Bleed 1986). Microlithic technology, sometimes combined with bifacial tools, is documented on the North American Pacific coast during the Early Holocene (Dixon 1999:178–181), as well as in Asia and the Far East (Imamura 1996), suggesting that such mixed traditions may have played a role in the early settlement of the North American Pacific Coast. Perhaps the mobility afforded by boats and insular locations poor in high-quality tool stone might have encouraged the use of microlithic technology by Eel Point's early mariners.

Theories of maritime cultural origins in South-

ern California have come and gone, but during the last 70 years the storyline has seldom veered from the notion of a single, trans-Holocene evolutionary trajectory tending toward a Late Holocene climax. The popularity of this model is easy to understand when we compare the relative richness of information available from Chumash ethnohistory and Late Holocene coastal archaeological sites with the paucity of archaeological information about coastal settlement during the Early Holocene. Only during the last two decades has it become evident that the Channel Islands were occupied by humans prior to the Middle Holocene. Archaeological information from the earliest periods of island settlement remains scanty. As a result, models of maritime culture change continue to reflect assumptions and conclusions about maritime cultural arrangements during the Late Holocene. Judging from the Eel Point data, this situation has probably created too narrow an understanding of the maritime cultural variation that existed during the span of prehistoric coastal occupation. If Eel Point is a guide, this spectrum of maritime adaptations is far more varied in time and space than current thinking recognizes. Once thought to be hallmarks of a Late Holocene maritime cultural climax, Eel Point shows that island seafaring and intensively maritime economies were well developed during the Early Holocene.

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